EE345M Final Exam   Fall 2003Version A Solution

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(10) Question 1. Add reference (REF02 = 5.00V) $V_{out} = 5V_1 - 3V_2 + V_{ref}$

Add ground ($V_g = 0V$) so sum of gains is 1 $V_{out} = 5V_1 - 3V_2 + V_{ref} + -2V_g$

Choose least common multiple of 2,3,5, which is 30, and choose resistors to get gains

(5) Question 2. Read Data Required is (125-30,125)=(95,125)
Read Data Available is
(later(60+t_1,60+t_2,earlier(125+[0,10]+t_3,145+t_4))
Both 60+t_1=95 and 60+t_2=95 means t_1=35 and
t_2=35, so choice **B, $5**

(15) Question 3. Consider this op amp circuit built with an OP07.

Part a) The input impedance is 30 kΩ.

Part b) The output impedance is $R_{out} \cdot (150 \text{ k}\Omega + 30 \text{ k}\Omega)/(K \cdot 30 \text{ k}\Omega) =$
$60\Omega \cdot (150+30)/(200000 \cdot 30)$, which is 0.0018$\Omega$.

Part c) The gain is 5, so the bandwidth is 400 kHz/5= 80 kHz.

(5) Question 4. The value is 2000/32 = 62.5

(5) Question 5. The 6812 signal pin, **LSTRB**, is used to differentiate.

(5) Question 6. Ten times faster, which is 10 Hz.

(5) Question 7. Answer C, the first interrupt starts the output, but TDRE becomes set right away because the data is transferred to the shift register. The second interrupt disarms.

(5) Question 8. B the **data flow graph**.

(5) Question 9. First write $17506 in 22-bit binary. 00,0001,0111,0101,0000,0110. Then put the top 8 bits in PPAGE, and the bottom 14 bits are added to the PPAGE window of $8000-BFFF.

            00000101 = $05   11,0101,0000,0110 = $3506, $8000+$3506=$B506

```
PPAGE =   | $05 |     ;
data = *((char *)( | $B506 |   ));
```

(5) Question 10. First write $17506 in 20-bit binary. 0001,0111,0101,0000,0110. Then put the top 8 bits in DPAGE, and the bottom 12 bits are added to the DPAGE window of $7000-7FFF.

            0001,0111 = $17   0101,0000,0110 = $506, $7000+$506 = $7506

```
DPAGE =   |     $17     |   ;
data = *((char *)( |     $7506     |   ));
```

(15) Question 11. A fuzzy logic controller

Part a) First slope is 256/8 = 32, second slope is 256/128=2

```
        .byte  $40,$F0,$20,$02    ; hot
```

Part b) 256*($F0-$A0)/($F0-$70)=256*80/128 =160.

Part c) 160 means probably true. More than maybe (128) and less than definitely (255)

(5) Question 12. The pulse-width measurement resolution is equal to the TCNT period, 2μs.

(5) Question 13. TCNT counts every 250 ns. The TOC5 interrupt period is 2.5 ms. The frequency measurement resolution is equal to 1 divided by the total count time, which is 400 Hz.

(10) Question 14. Just fill in the best term from the word bank.

Part a) **aging**

Part b) **starvation**

Part c) **deadlock**

Part d) **blocked**

Part e) **bounded waiting**